

A COLLECTION OF *FRULLANIA* FROM NILGIRI  
WITH *F. DENSILOBA* ST. AS A NEW RECORD FOR INDIA<sup>1</sup>

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(With two text-figures)

**Key words:** Bryophyta, Hepaticae, Jungermanniales, Jubulaceae, *Frullania densiloba*

*Frullania densiloba* St. is reported for the first time, not only from India, but also from Tropical Asia, along with the other species of *Frullania* distributed in the Nilgiri hill ranges. A key to segregate various species of *Frullania* from Nilgiri is provided.

The present communication is based exclusively on a collection of *Frullania* from the Nilgiri hill ranges to evaluate the frequency and variety of the genus in this area. *Frullania* shows a very high level of structural diversity and often becomes a puzzle in species determination. Apart from its morphological diversity, each species can be recognized by its typical lobule, presence and absence of ocelli, perianth morphology, leaf lobe shape and underleaves.

While working on the collection of the genus from the Nilgiris, an interesting ocellate species of *Frullania* other than *Frullania tamarisci*, a well-known ocellate species from Nilgiri and other regions of South India was in hand. On critical study, this plant showed very close resemblance to *Frullania densiloba* St., a species distributed in Eastern Asiatic temperate region (including Japan, Ryukyu, Formosa, Quelpart, Botel Tobago) (Kamimura 1961) and clearly different from *Frullania tamarisci*. The discovery of *F. densiloba* from the Nilgiris thus constitutes a new record, not only from India but also from Tropical Asia.

A key to segregate various species of *Frullania* of the Nilgiris is provided along with an illustrated morpho-taxonomic account of *F. densiloba*.

KEY TO THE SPECIES

- |    |   |                       |
|----|---|-----------------------|
| 1. | Plant dioecious .....   | 2                     |
| —  | Plant monoecious .....  | 3                     |
| 2. | Leaf-lobes ocellate (with ocelli) .....   | 4                     |
| —  | Leaf-lobes non-ocellate (without ocelli) .....  | 5                     |
| 3. | Leaf-lobule helmet shaped, perianth 4-5 keeled .....  | <i>F. wallichiana</i> |
| —  | Leaf-lobule large, cucullate to subcucullate, perianth usually 4 keeled .....   | <i>F. neurota</i>     |
| 4. | Leaf-lobes acute to acuminate, rarely obtuse to rounded, ocelli in 1-2 rows, 10-20 cells long, lobule saccate, subparallel with the stem and not inclined, slightly apart from the stem, female inflorescence terminal on short lateral branches, underleaves bifid, much wider than the stem, sinus obtuse .....             | <i>F. tamarisci</i>   |
| 4. | Leaf-lobes slightly concave, ovate, with rounded apex, ocelli in a single row, less than 10 cells long, lobule clavate, almost parallel with the stem and inclined towards the stem, female inflorescence terminal on a leading branch, underleaves bifid, as wide as stem or slightly wider than the stem, sinus acute ..... | <i>F. densiloba</i>   |
| 5. | Leaf-lobes squarrose .....  | <i>F. squarrosa</i>   |
| —  | Leaf-lobes ovate with obtuse or rounded apex .....  | 6                     |
| 6. | Rostrum of leaf-lobule elongated which forms a piliferous beak .....  | <i>F. acutiloba</i>   |
| —  | Leaf-lobules usually without rostrum .....  | 7                     |
| 7. | Leaf-lobules variable in shape, explanate to saccate, perianth ovoid, 5 keeled .....  | <i>F. muscicola</i>   |
| —  | Leaf-lobules campanulate, perianth pyriform, usually 4 keeled .....   | <i>F. campanulata</i> |

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*Frullania densiloba* St. Species Hepaticarum IV: 549-550 (1909); Kamimura, Jour. Hattori Bot. Lab. No. 24: 69-73 (1961).

Plants small, 10.3-13.6 mm in length, brownish, having characteristic *Frullania*-type branching, stem rounded (in a cross section), 0.06-0.07 mm in diameter, differentiated into distinct cortical and medullary zone, cortical cells 6.3-7.6 x 3.1-3.8  $\mu$ m, medullary cells 22.3-26.6 x 13.4-15.2  $\mu$ m and are relatively larger than cortical cells. Leaves complicate bilobed, leaf lobe concave, ovate with somewhat rounded apex, contiguous to loosely imbricate, 0.28-0.32 mm long and 0.20-0.24 mm wide, apical cells of lobe 11.4-15.2 x 7.6-11.4  $\mu$ m, median and basal cells 15.2-22.8 x 7.8-11.4  $\mu$ m with thickened walls, trigones not clear, ocelli 4-8 in number, uniseriate to scattered, 22.8-26.6 x 19.0-21.3  $\mu$ m, oil bodies not seen. Leaf-lobules almost parallel with the stem and about half of its own width covering the stem (i.e. slightly inclined towards the stem), clavate, 0.15-0.16 mm long and 0.08-0.11 mm wide, mouth rounded, stylus 4-celled, 25.3-28.2  $\mu$ m long and 11.3-15.2  $\mu$ m wide. Underleaves cauline, distant, transversely inserted, oblong, lateral margin almost parallel to the stem, 0.10-0.12 mm long and 0.068-0.070 mm wide, apex bilobed up to half of its length, sinus acute.

Dioecious (Figs 1, 2). Male inflorescence nearly globose on short lateral branches, bracteoles restricted to the base of inflorescence, bracts in 2-3 pairs, ovate, 0.52 mm long and 0.44 mm wide, apical cells of bract 7.5-17.5 x 6.25-12.5  $\mu$ m, median and basal cells 7.5-12.5 x 12.5-22.5  $\mu$ m, male bracteoles bilobed 157.2-162.5  $\mu$ m long and 51-55  $\mu$ m wide. Female inflorescence terminal, bracts three, bract lobe ovate to oblong with conspicuous dentitions at margin, 0.57 mm long and 0.32 mm wide, at fully stretched condition, 0.77 mm long and 0.55 mm wide, bracteoles bilobed to about half of its length, sinus narrow, two or three in number, 0.49 mm long and 0.24 mm wide, at fully stretched condition 0.53 mm long and 0.33 mm

wide, dentate. Perianth almost one fourth to half emergent, 3.5-3.9 mm long and 1.64-1.76 mm wide, obovate, 3-keeled (2 lateral and 1 ventral), apex rounded with a distinct rostrum.

**Distribution and Ecology:** Corticolous epiphyte, being reported for the first time from South India: Tamil Nadu: Nilgiri: Ootacamund, Dodabetta peak.

Grows with *Plagiochila* sp., *Drepanolejeunea* sp., *Leucolejeunea* sp., *Radula* sp., *Frullania tamarisci* between 2,300-2,600 m, temperature ranging between 10-25 °C, with annual rainfall up to 400 cm.

**Range:** Japan, Quelpart, Ryukyu, Formosa, Botel Tobago, India.

**Specimens examined:** India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta, Leg.: P.K. Verma and A. Alam, Det.: S.C. Srivastava and A. Alam. LWU-13453/2001, 13477/2001.

The following species of *Frullania* have been observed along with *F. densiloba* St. in the collection from Nilgiris. (See Parihar *et al.* 1994, Nath and Asthana 1998). All these species listed below were reported earlier from Sikkim Himalayas (Mitten 1861) except *F. campanulata* (Chopra 1938) and *F. acutiloba* (Mitten 1861) which were reported from South India.

1. *Frullania tamarisci* (L.) Dum. Sde. Lac. in Miquel, Ann. Mus. Lugd-Batavi 1: 313 (1836).  
Basionym: *Jungermannia tamarisci* L., Sp. Pl. 1134 (1753).

**Characteristics of species:** Dioecious, with saccate lobule, ocelli in 1-2 rows, 10-20 cells long, rarely scattered, and 3 keeled perianth.

**Distribution and Ecology:** Very common in Nilgiri hills and elsewhere, South India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta peak, Government Botanical Garden, Pykara, Avalanche. Grows on tree bark associated with *Plagiochila* sp., *Leucolejeunea* sp., *Lophocolea* sp., *Frullania neurota*, *F. squarrosa* and *F. densiloba*.

**Range:** Japan, Korea, China, Formosa, Philippines, India, Ceylon.

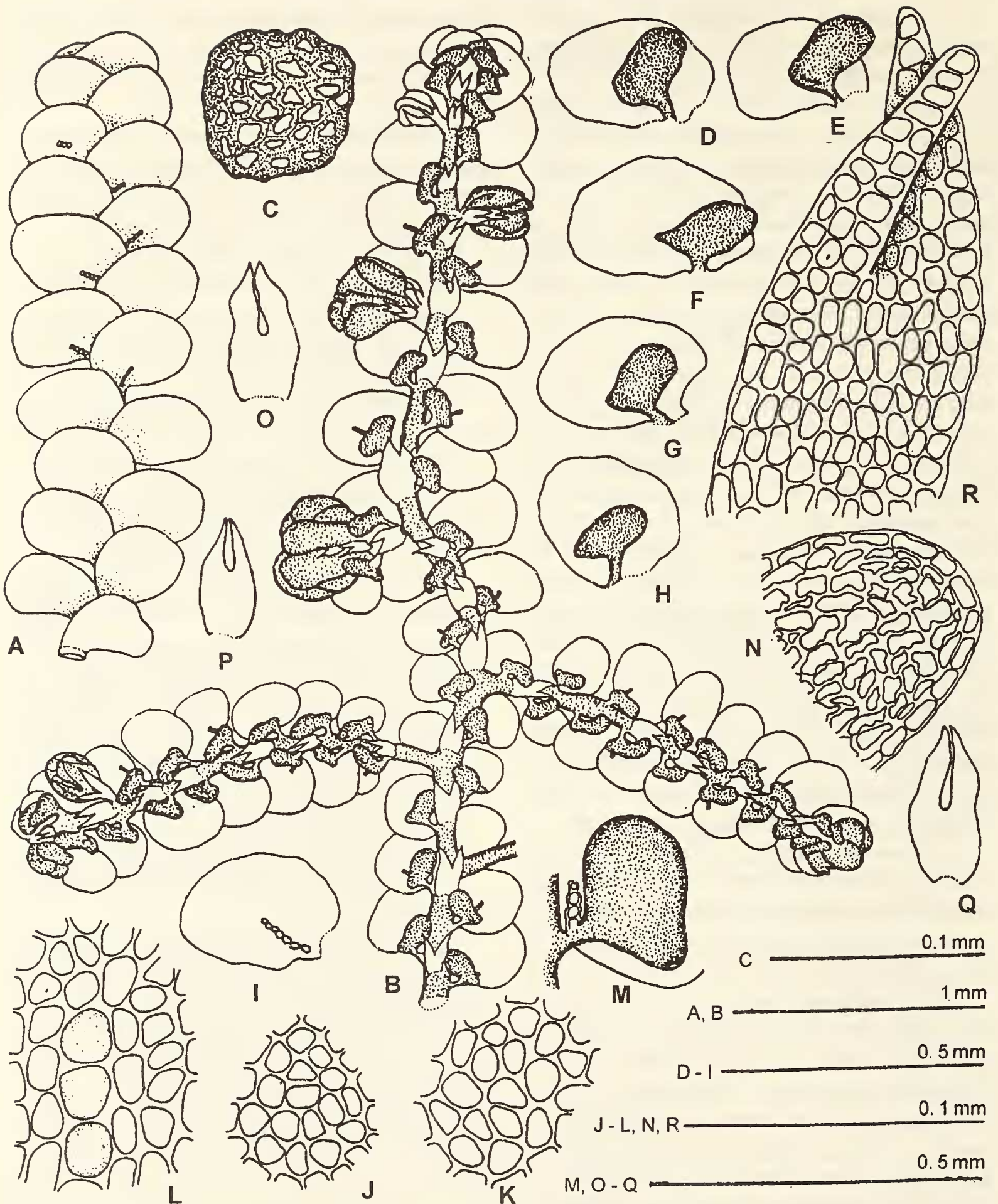


Fig. 1: *Frullania densiloba* St., A. Male plant (dorsal view), B. Male plant (ventral view), C. T.S. of stem, D-H. Leaf-lobes with lobules, I. Leaf-lobe with ocelli, J. Apical cells of leaf-lobe, K. Median cells of leaf-lobe, L. Basal cells of leaf-lobe, M. Leaf-lobule with stylus, N. Cells of lobule, O-Q. Underleaves, R. Underleaf (cellular)

**Specimens examined:** India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta: LWU - 6863/82, 6873/82, 6885/82, 6889/82, 6892/82, 6896-97/82, 6900-01/82, 6903/82, 6934/82, 6938/82, 6946/82, 6949/82, 6952-55/82, 6957-58/82, 6969/82; 12432-33/2000, 12462/2000, 13451/01, 13455/01, 13464/01, 13480-81/01, 13484/01; Government Botanical Garden: LWU-6974/82; Pykara: LWU-12672/2000, 12704/2000, 12748/2000; Avalanche: LWU-12544/2000, 12553/2000.

2. *Frullania wallichiana* Mitt. Proc. Linn. Soc. 5. 118(1861)

**Characteristics of species:** Monoecious, with helmet shaped, large lobule and 4-5 keeled cylindrical perianth.

**Distribution and Ecology:** South India: Tamil Nadu: Nilgiri: Pykara, Krutukuli. Plants grow on bark of trees with *Ptychanthus striatus* and *Lejeunea* sp.

**Range:** Himalayas, India, Sri Lanka, Sumatra, Java, Philippines, Africa, Central and South America, New Guinea.

**Specimens examined:** India: Tamil Nadu: Nilgiri: Pykara: LWU-12607/2000, 12675/2000, 12691-92/2000, 12699/2000, 12714/2000, 12715/2000, 12722/2000, 12755-58/2000, 12760/2000, 12761/2000; Krutukuli: LWU-13709/2001.

3. *Frullania neurota* Tayl. J. Bot. 5: 400 (1846)

**Characteristics of species:** Monoecious, lobules large, cucullate or subcucullate, without beak, perianth 4 keeled.

**Distribution and Ecology:** South India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta, Government Botanical Garden, Soil and Water Conservation Institute (SWCI) Road, Krutukuli, Pykara, Avalanche. Grows on tree bark in association with *Radula* sp., *Lophocolea* sp., *Frullania campanulata*, *Frullania tamarisci*, and *Frullania wallichiana*.

**Range:** Widely distributed in tropical Asia, Hawaii, Mexico, India.

**Specimens examined:** India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta: LWU-6874/82, 6905/82, 6916/82, 6921/82, 6953/82, 6962/82, 6963/82, 6964/82; 12411/2000, 12414/2000, 12422/2000, 12424/2000, 12440/2000, 12459/2000, 12479/2000, 12487-88/2000, 13455/2001, 13464/2001, 13480-84/2001, 13486/2001; Government Botanical Garden: LWU-6974/82, 6987/82, 6988/82, 6989/82, 6991/82, 12791/2000, 12796/2000, 12803/2000. Pykara: 12667/2000, 12672/2000, 12677/2000, 12678/2000, 12683/2000, 12684/2000, 12689/2000, 12692/2000, 12693/2000, 12700/2000, 12714/2000, 12758/2000, 12761/2000, 12769/2000, 12783/2000; Avalanche: 12568/2000, 12590/2000, 12613/2000, 12623/2000, 12665/2000; Soil and Water Conservation Institute (SWCI) Road: 13709/2001. Krutukuli: 13701/2001, 13702/2001, 13704/2001, 13705-06/2001, 13712/2001, 13714/2001, 13715/2001, 13724/2001, 13730/2001.

4. *Frullania squarrosa* (R., Bl. et Nees) Dum. Rec. d'obs 13(1835)

Basionym: *Jungermannia squarrosa* R., Bl. et Nees Nova Acta Acad. Caes. Leop. Carol. 12: 219 (1824)

**Characteristics of species:** Dioecious, leaves squarrose, saccate, with helmet-shaped leaf lobules variable in size and 3-keeled perianth.

**Distribution and Ecology:** South India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta, Government Botanical Garden, Soil and Water Conservation Institute (SWCI) Road, Pykara, Avalanche, Krutukuli. Plants grow on soil as well as tree bark in association with *Lophocolea* sp., and *Lejeunea* sp.

**Range:** Widely distributed in warm-temperate regions of the world.

**Specimens examined:** India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta: LWU-6885/82, 6890/82; 13464/01. Government Botanical Garden: LWU-12803/2000; Pykara: LWU-12758/2000, 12759/2000; Avalanche: LWU-

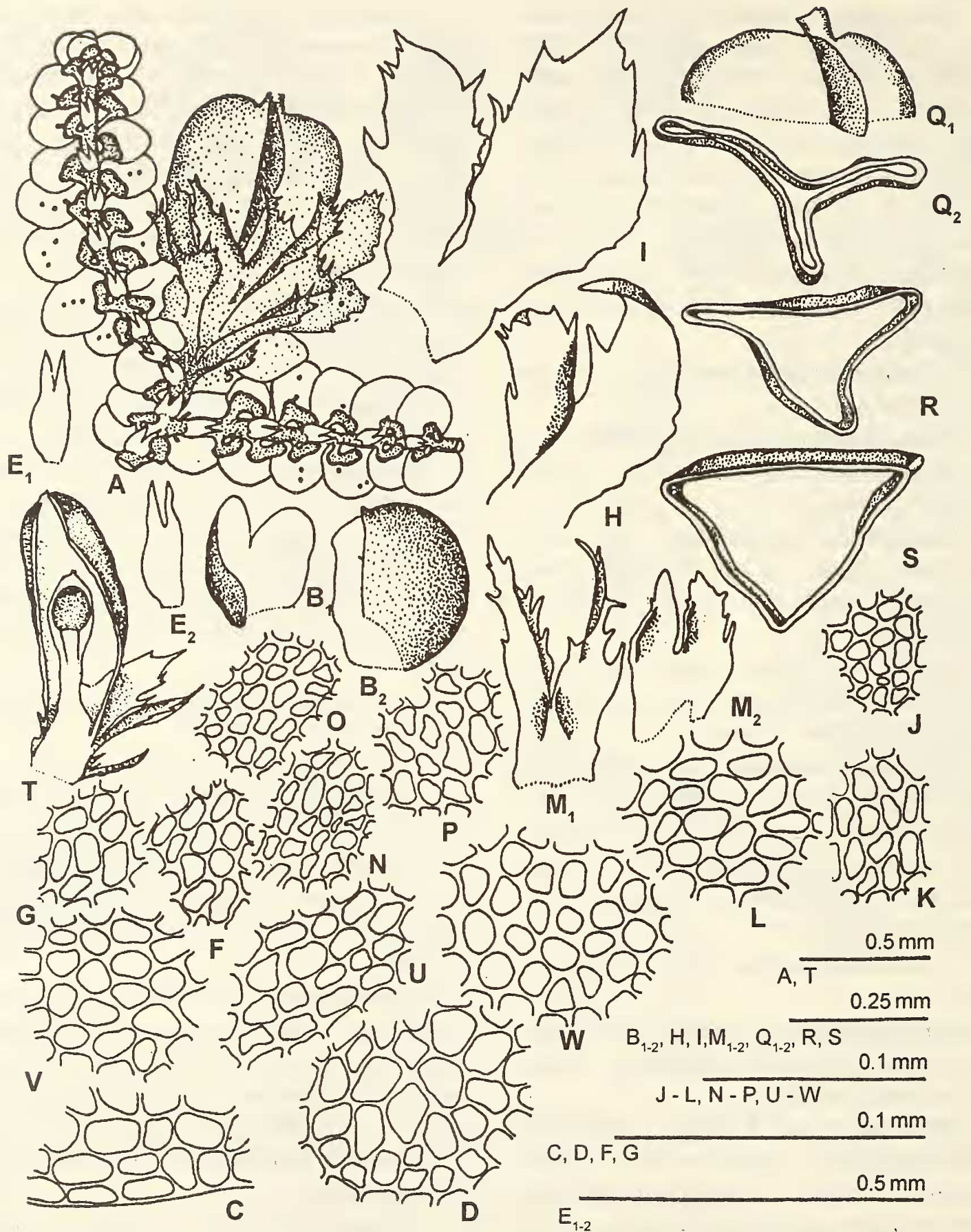


Fig. 2: *Frullania densiloba* St., A. Female plant (Ventral view), B<sub>1-2</sub>. Male bracts, C. Apical cells of male bract, D. Median cells of male bract, E<sub>1-2</sub>. Male bracteoles, F. Apical cells of male bracteole, G. Median-basal cells of male bracteole, H. Female bract, I. Female bract (stretched), J. Apical cells of female bract, K. Median cells of female bract, L. Basal cells of female bract, M<sub>1-2</sub>. Female bracteoles, N. Apical cells of female bracteoles, O. Median cells of female bracteole, P. Basal cells of female bracteole, Q<sub>1,2</sub>. T.S. of perianth (Apical portion), R. T.S. of perianth (Middle portion), S. T.S. of perianth (Basal portion), T. L.S. of perianth, U. Apical cells of perianth, V. Median cells of perianth, W. Basal cells of perianth

12595/2000; Krutukuli: LWU-13701/2001, 13707/2001, 13710/2001, 13711/2001.

5. *Frullania muscicola* St., Hedwigia 33: 146(1894)

**Characteristics of species:** Dioecious, leaf lobule saccate with 5 to 6 keeled perianth.

**Distribution and Ecology:** South India: Tamil Nadu: Nilgiri: Ootacamund Dodabetta, Government Botanical Garden, Pykara, Avalanche, Krutukuli. Plants grow on tree bark and also on soil with *Plagiochila* sp., *Radula* sp., *Lophocolea* sp., *Lejeunea* sp., *Frullania squarrosa*, and *F. tamarisci*.

**Range:** China, Himalayas, India.

**Specimens examined:** India, Tamil Nadu: Nilgiri: Ootacamund: Dodabetta: LWU-6880/82, 6903/82, 6923/82, 6953/82, 6960/82, Government Botanical Garden: LWU-6978/82, 6994/82, 7029/82, 7035/82; Pykara: LWU-12686/2000, 12727/2000, 12748/2000, 12760/2000; Avalanche: LWU-12644/2000; Krutukuli: LWU-13711/2001.

6. *Frullania campanulata* Sde. Lac. Nederi. Kruidk. Arch 3: 422(1854).

**Characteristics of Species:** Dioecious, leaf lobule campanulate, longer than broad, perianth 4-keeled, with smooth surface.

**Distribution and Ecology:** South India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta, Government Botanical Garden, Soil and Water Conservation Institute (SWCI) Road, Pykara, Avalanche. Epiphyte, grows in association with *Microlejeunea* sp. *Radula* sp., *Frullania neurota*, *Frullania tamarisci*, *Metzgeria* sp., and *Plagiochila* sp.

**Range:** Sumatra, Java, India.

**Specimens examined:** India, Tamil Nadu: Nilgiri: Ootacamund: Dodabetta: LWU-6873/82, 6888/82, 6909/82, 6917/82, 6930/82, 6954/82, 6962/82, 6963-64/82; 12411/2000, 12414/2000, 12422/2000, 12424/2000, 12440/2000, 12459/2000, 12479/2000, 12487/2000, 12488/2000, Government Botanical Garden: 6987/82, 6988/82, 6989/82; Pykara: LWU-12668/2000, 12696/2000, 12697/2000, 12721/2000, 12744/2000, 12750/2000, 12760/2000, 12764/2000; Avalanche: LWU-12571/2000, Soil and Water Conservation Institute (SWCI) Road: LWU-12379/2000, 12388/2000, 13701/2001, 13711/2001; Theetukal: LWU-13714/2001.

7. *Frullania acutiloba* Mitt., Proc. Linn. Soc. 5: 120(1861).

**Characteristics of species:** Dioecious, leaf lobule explanate to helmet-shaped, large with piliferous beak, perianth 3-keeled.

**Distribution and Ecology:** South India: Tamil Nadu: Nilgiri: Ootacamund: Dodabetta, Government Botanical Garden, Theetukal. Epiphyte, associated with *Cheilolejeunea* sp., *Radula* sp., *Metzgeria* sp., *Frullania tamarisci* and *F. squarrosa*.

**Range:** India, Ceylon, Java.

**Specimens examined:** India, Tamil Nadu: Nilgiri: Ootacamund: Dodabetta: LWU-6934/82, 6952/82, Government Botanical Garden: LWU-12808/2000; Theetukal: LWU-13720/01, 13721/01, 13722/01, 13724/01, 13726/01.

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